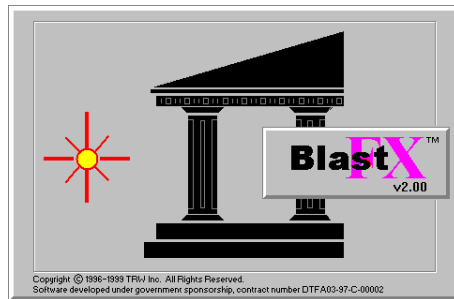


# Blast/FX

## Explosive Effects Analysis Software



## NDIA Security Technology Symposium

Kelly Leone  
Federal Aviation Administration  
Aviation Security Research & Development Division (AAR-510)  
William J. Hughes Technical Center  
Atlantic City, NJ

June 2000



# Agenda

- Program Background
- Blast/FX Model  
Overview
- Studies
- Questions

► **Program  
Background**

**Blast/FX  
Model  
Overview**

**Studies**

**Questions**



# Program Background

# Recent Events

## ► Program Background

### Blast/FX Model Overview

### Studies

### Questions

Concerns about terrorist attacks have increased over the past several years:

- **World Trade Center Bombing** - Feb. 26, 1993. Killed 6, injured over 1000.
- **Oklahoma City Bombing** - April 19, 1995. Killed 168, injured over 500.
- **Khobar Towers Bombing** - June 25, 1996. Killed 19, injured over 330.
- **U.S. Embassies, Africa** - August 7, 1998. Killed 247, injured over 5000.



Alfred P. Murrah Building, Oklahoma City

# Assessing Explosive Effects

## ► Program Background

### Blast/FX Model Overview

### Studies

### Questions

- To address evolving security concerns, the FAA identified the need for an improved capability to assess the effects of explosions against civil aviation facilities and their occupants.
- This capability was aimed at:
  - Complimenting existing department resources
  - Assisting in vulnerability assessments
  - Providing a sound means to evaluate alternative precautionary measures

## Recent Event Timeline

- |             |  |
|-------------|--|
| <b>1993</b> | <i>World Trade Center Bombing</i><br>Killed 6, injured over 1000   |
| <b>1995</b> | <i>Oklahoma City Bombing</i><br>Killed 168, injured over 500   |
| <b>1995</b> | <i>Justice Department Special Report</i><br>Recommends improved security at all federal buildings  |
| <b>1995</b> | <i>National Research Council Study</i><br>Study concludes that: "Attacks against civilian buildings pose an unquantifiable but real threat to the people of the United States."  |
| <b>1996</b> | <i>Khobar Towers Bombing</i><br>Killed 19, injured over 330  |
| <b>1996</b> | <i>Downing Task Force Report</i><br>Recommends that DOD adopt improved prescriptive physical security standards.   |
| <b>1998</b> | <i>U.S. Embassies Bombing, Africa</i><br>Killed 247, injured over 5000   |
| <b>1999</b> | <i>U.S. Department of State Accountability Review Board</i><br>Chairman Admiral Crowe concludes that "saving lives and adequately addressing our security vulnerabilities on a sustained basis must be given a high priority if we are to prevent such tragedies in the future." |



# Program Chronology

## ▶ Program Background

### Blast/FX Model Overview

### Studies

### Questions

- Program started November 1996.
- Blast/FX v1.00 delivered September 1997.
- Blast/FX user group meetings held winter 1997, identified further development areas for software.
- Blast/FX v2.00 beta delivered September 1998.
- Beta testing began November 1998, continued through March 1999. Beta testers (over 180) included representatives from organizations including:

#### Representative Blast/FX Beta Test Organizations

- |   |  |
|---|--|
| • Federal Aviation Administration (FAA)   | • US Capitol Police                            |
| • US Army Corps of Engineers (USACE)      | • Defense Intelligence Agency (DIA)            |
| • Defense Threat Reduction Agency (DTRA)  | • US Department of Energy (DOE)                |
| • Technical Security Working Group (TSWG) | • US Department of Transportation (DOT)        |
| • US Department of State (DOS)            | • Federal Bureau of Investigation (FBI)        |
| • Central Intelligence Agency (CIA)       | • Bureau of Alcohol Tobacco and Firearms (ATF) |
| • US Secret Service                       | • Others                                       |

# Program Chronology

## ▶ Program Background

### Blast/FX Model Overview

### Studies

### Questions

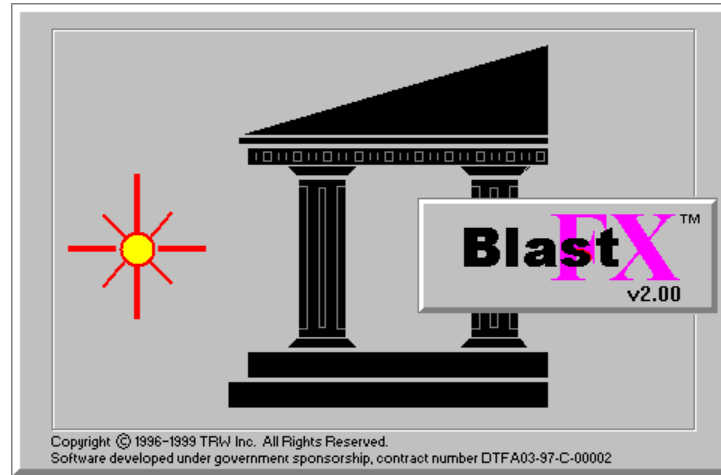
- Results and feedback from the beta test were analyzed.
- Software was updated to include some bug fixes and some enhancements, resulting in current version - Blast/FX v2.00.
- Conducted first Blast/FX training session, April 2000.
- Continue to distribute Blast/FX to:
  - Federal, state, and local government agencies.
  - Airport authorities operating in the United States.
  - Other FAA-approved organizations acting on behalf of the US government.
- To date, 365 copies of the software have been distributed by FAA.
- Currently concluding last anticipated development efforts to result in Blast/FX v2.20. Expected release approximately June 2000.

Program  
Background

► **Blast/FX  
Model  
Overview**

Studies

Questions



# Model Overview



# Component Specification

Program  
Background

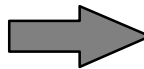
► **Blast/FX  
Model  
Overview**

Studies

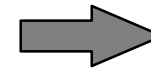
Questions



Analyst builds up  
Project-specific  
component  
“Library”



Simple-to-use  
structural component  
specification dialogs  
speed the process



Custom Dialogs for  
each component type  
(like walls, beams,  
columns, etc)

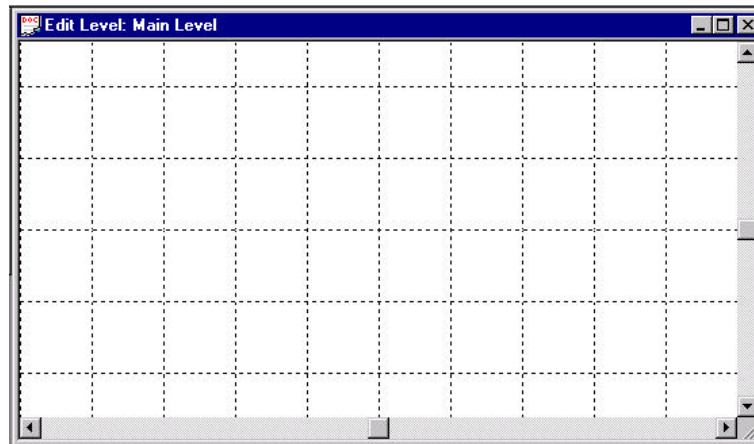
# Component Layout

Program  
Background

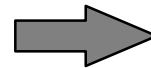
► **Blast/FX  
Model  
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Studies

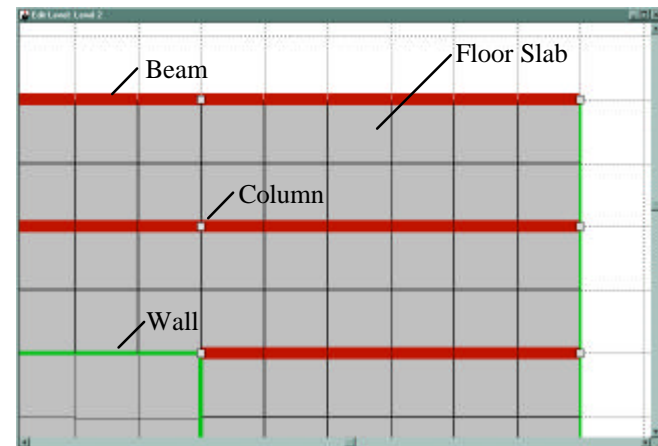
Questions



Components added in 2-D  
Floor Plan Editor



Analyst draws out floor-plan  
and places components. All  
point-and-click.



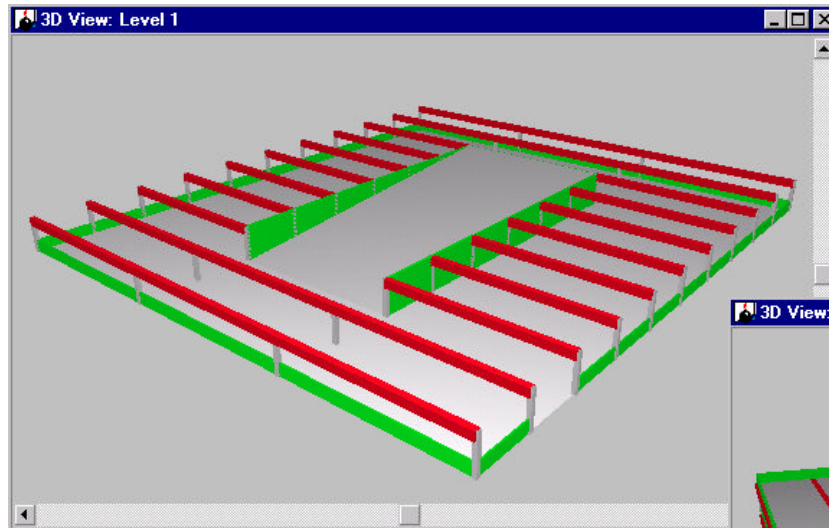
# Component Layout

Program  
Background

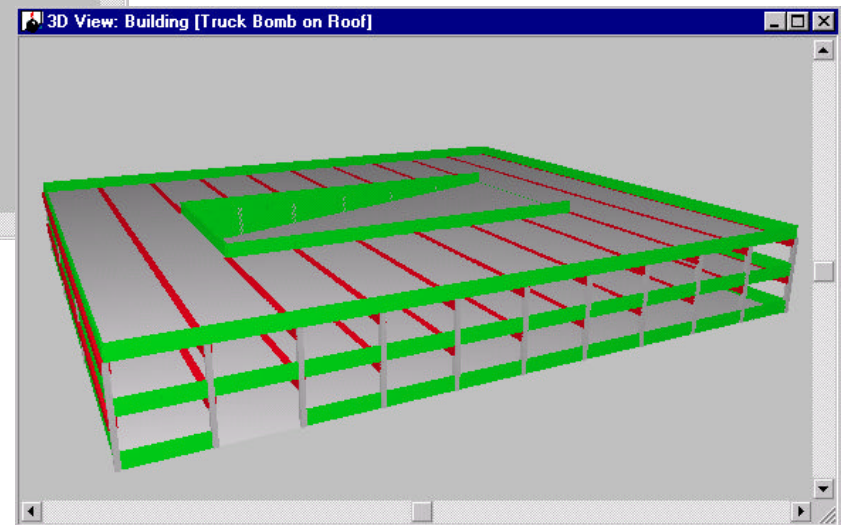
► Blast/FX  
Model  
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Studies

Questions



Facility constructed on a  
Floor by Floor basis, until...



Entire Facility is represented

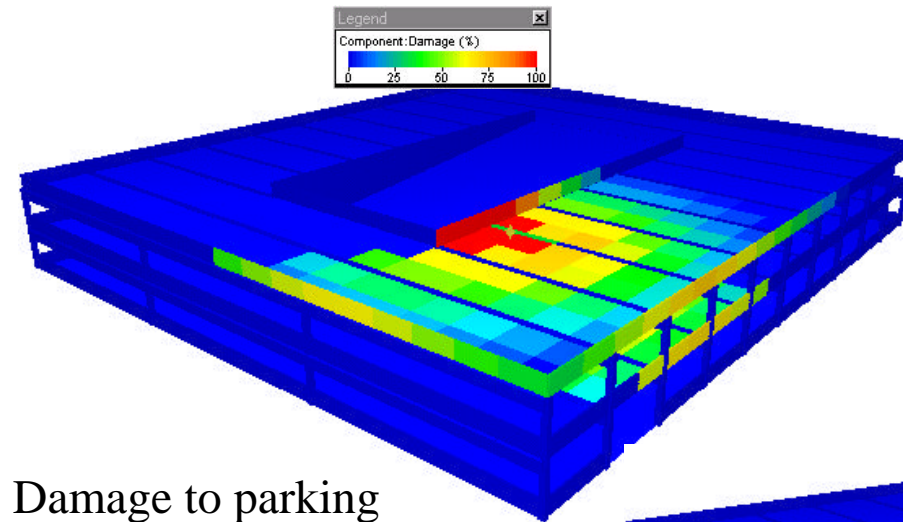
# Damage Estimates

Program  
Background

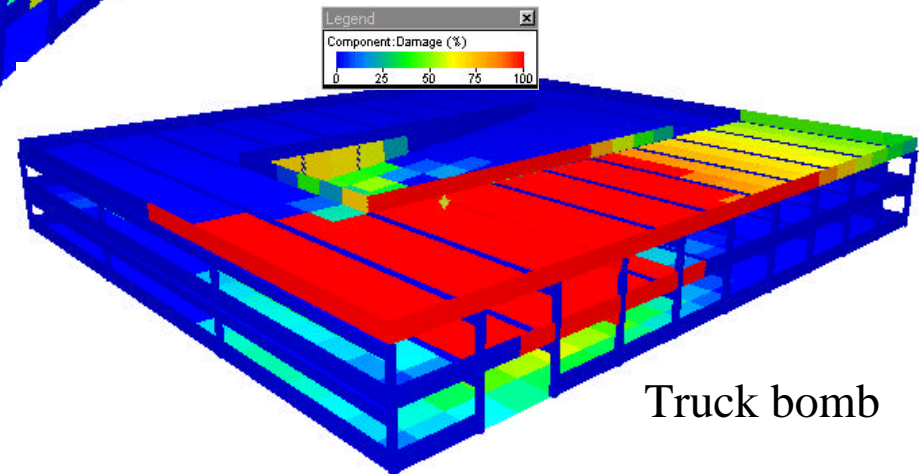
► **Blast/FX  
Model  
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Studies

Questions



Damage to parking  
garage from a car  
bomb on the upper  
deck.



Truck bomb



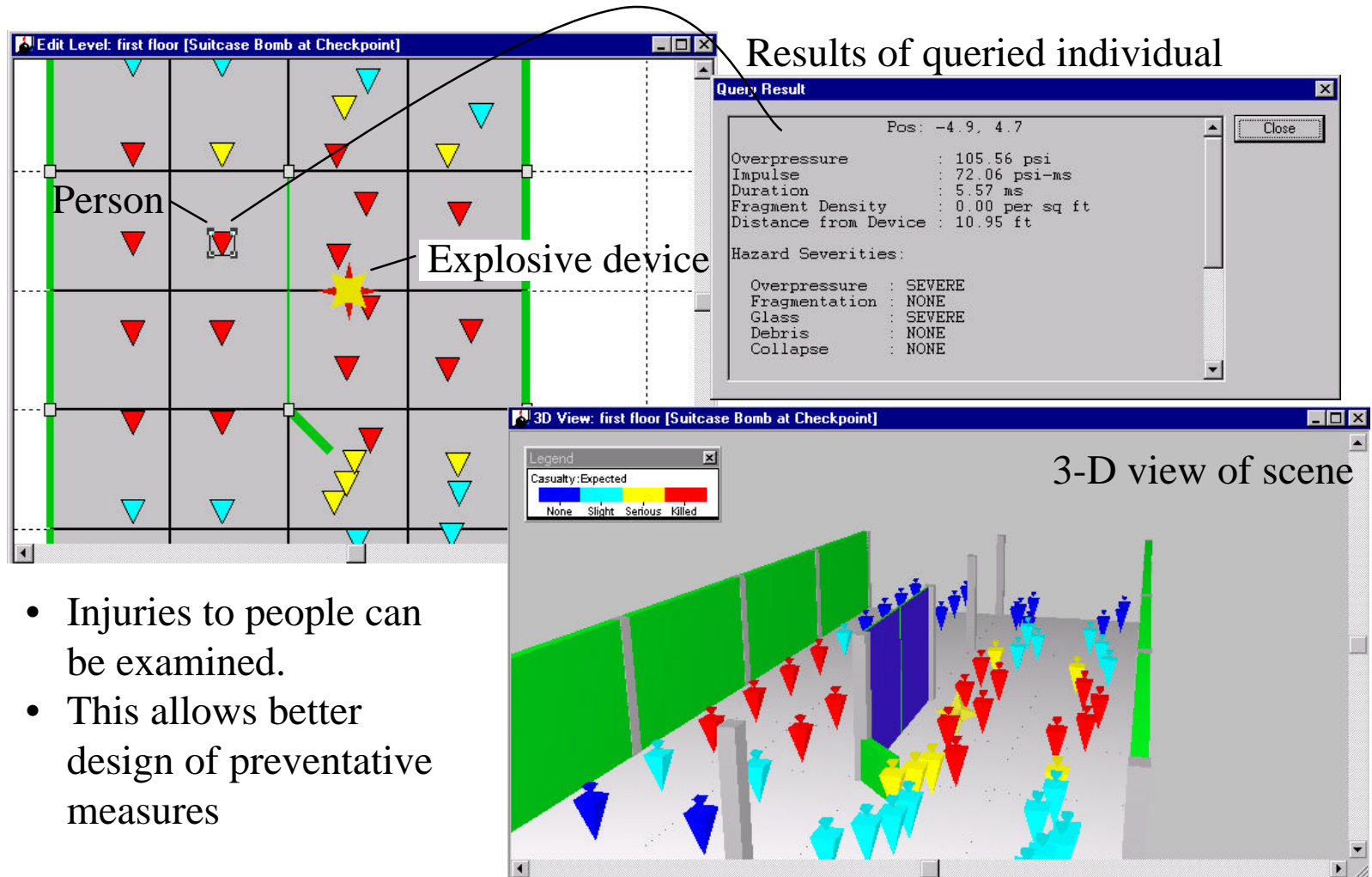
# Injury Estimates

Program  
Background

► Blast/FX  
Model  
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Studies

Questions



- Injuries to people can be examined.
- This allows better design of preventative measures



# Progressive Collapse

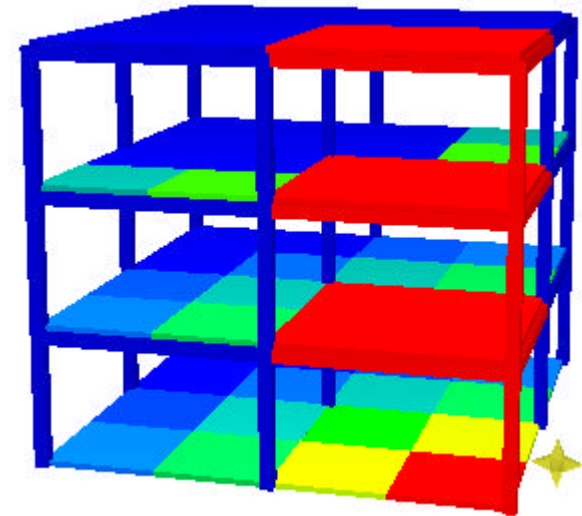
Program  
Background

► **Blast/FX  
Model  
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Studies

Questions

- Blast/FX calculates damage to done to components directly by the blast.
- Blast/FX also calculates progressive collapse
- Progressive collapse occurs in multi-story buildings when lower-story, load-bearing components are destroyed by a blast.
- Blast/FX uses two algorithms to accomplish this:
  - First, Blast/FX initializes all runs by assessing the geometrical relationships between components to develop support relationships.
  - Second, after damage done directly by the blast is assessed, Blast/FX applies a recursive algorithm to search for destroyed components belonging to all component groups. If found, other components depending on the destroyed component for their support are marked as collapsed and the process continues until complete.

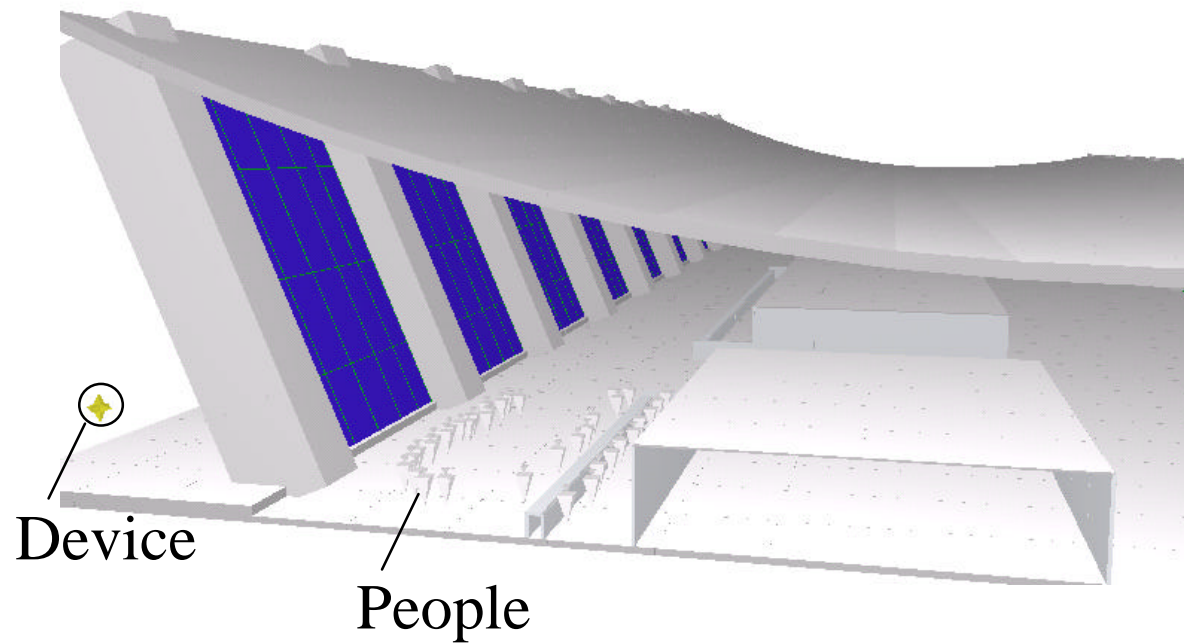


Weapon destroys exposed column, upper-level beams, columns, floor slabs collapse.

# Studies

The software has been used to support a number of assessments, including:

- Aviation Facilities



Program  
Background

Blast/FX  
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Overview

► Studies

Questions

# Studies

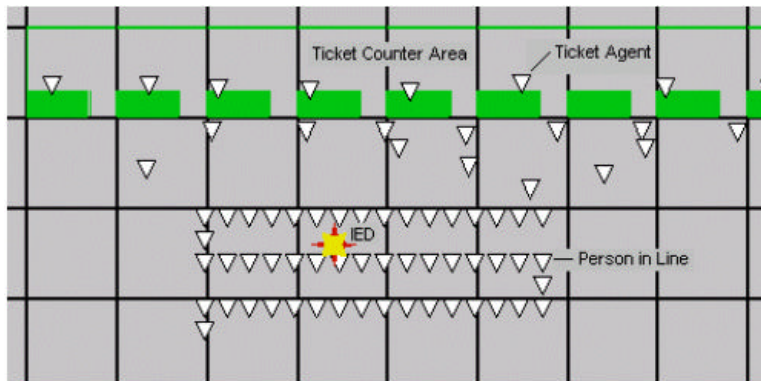
- Aviation related scenarios (ticket counter)

Program  
Background

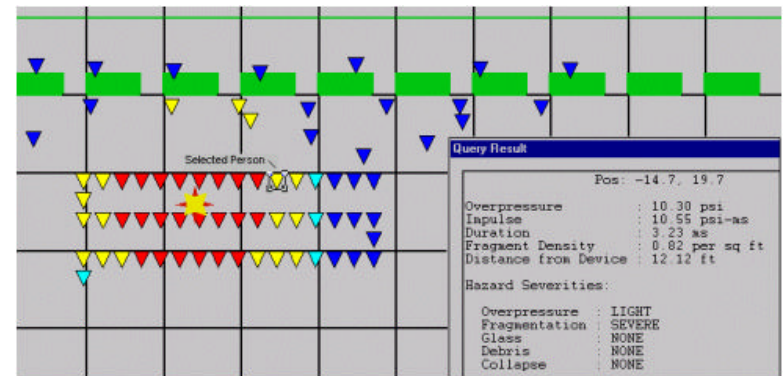
Blast/FX  
Model  
Overview

► Studies

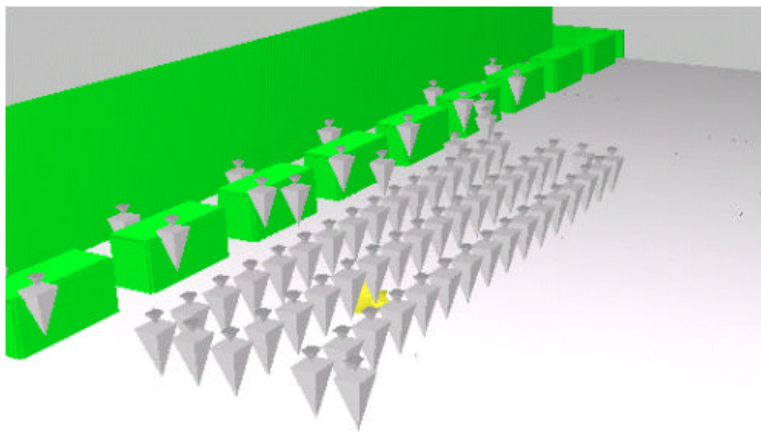
Questions



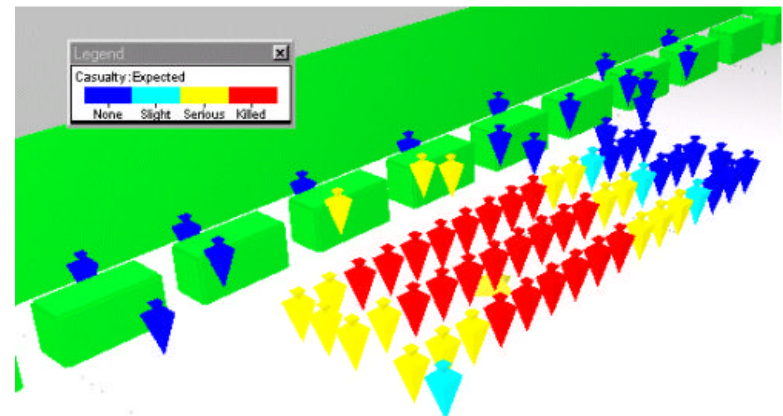
2D Representation of Ticket Counter Area



Individual Hazard Severities



3D Representation of Ticket Counter Area



Small IED at Ticket Counter, Estimated Casualties

# Studies

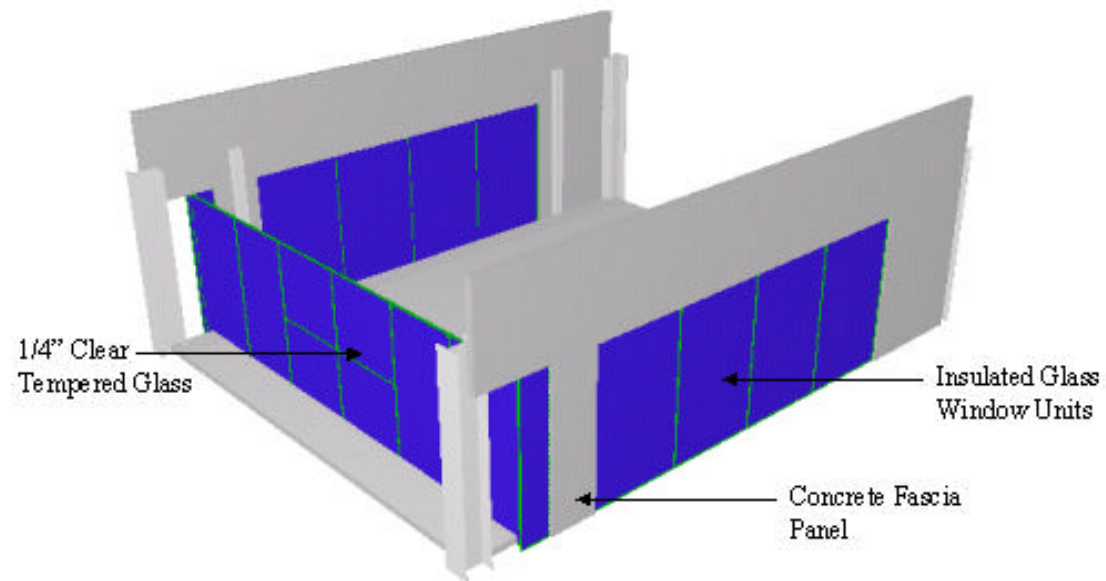
- Proposed security-related area at a US airport.

Program  
Background

Blast/FX  
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Overview

► **Studies**

Questions





# Studies

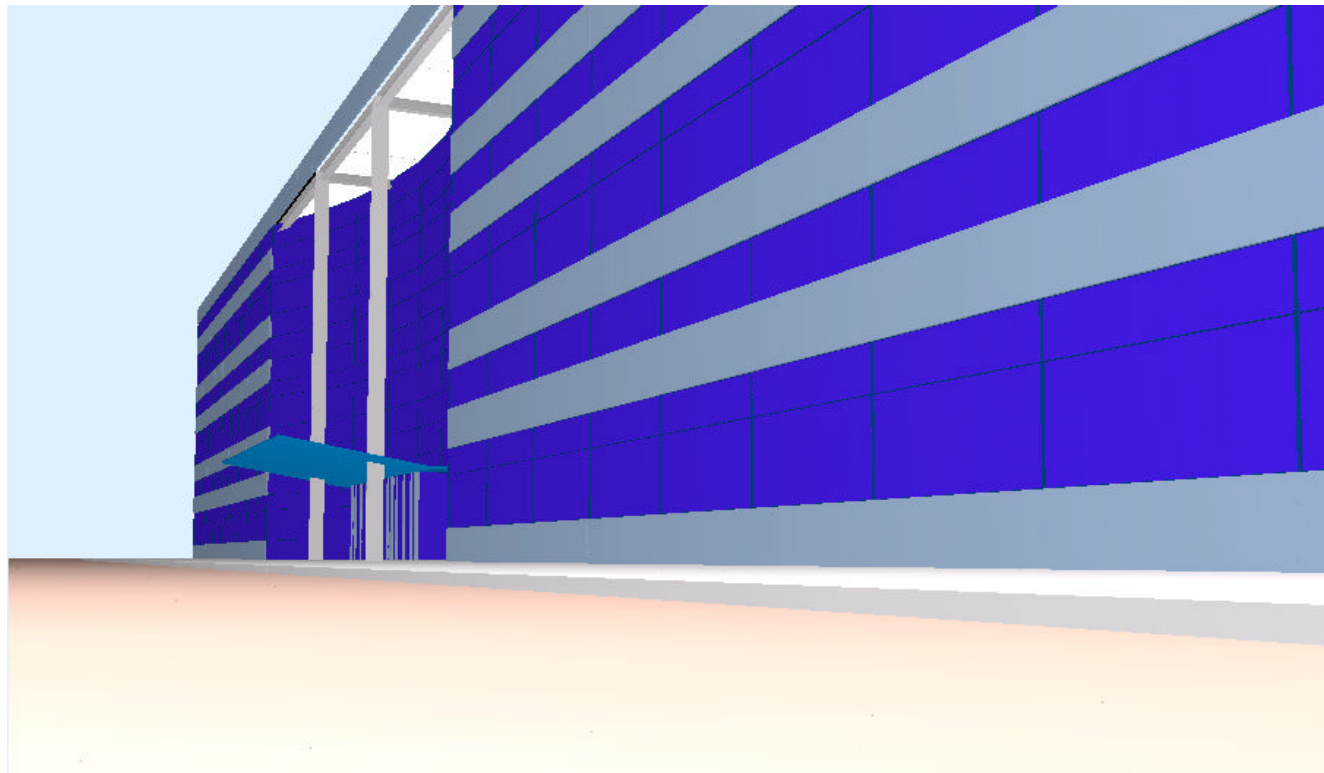
- Proposed new FAA Facility.

Program  
Background

Blast/FX  
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► **Studies**

Questions





# Studies

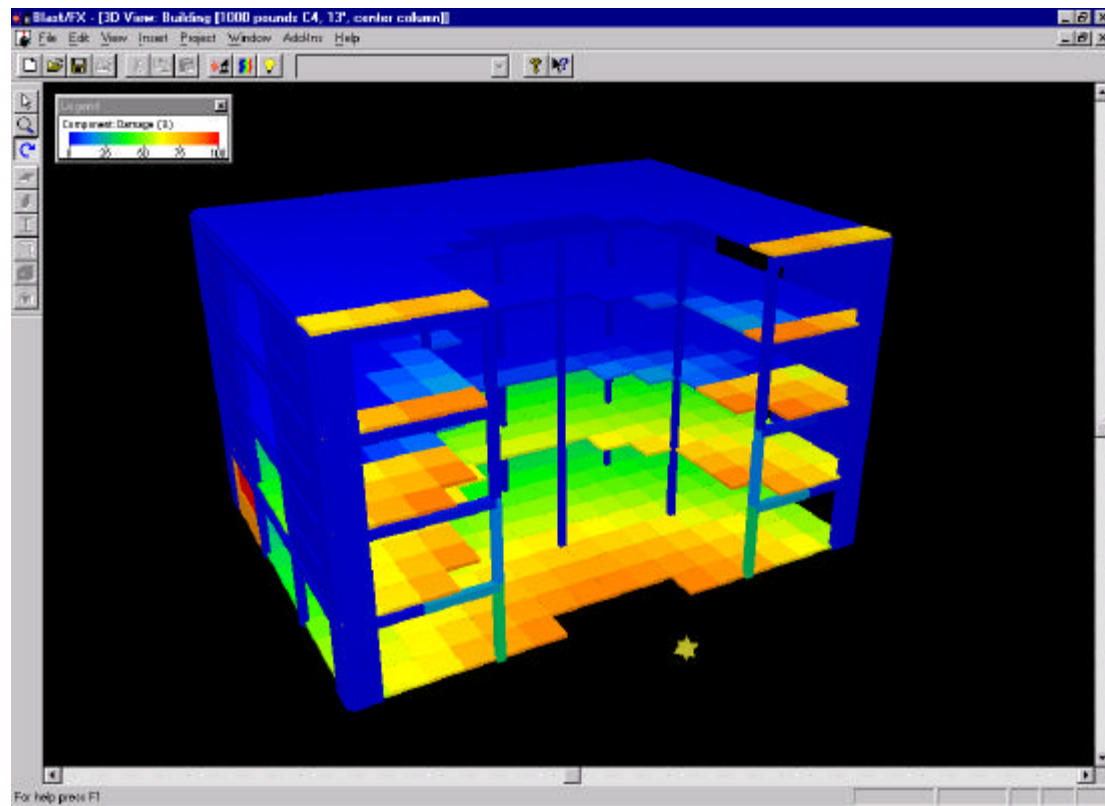
- DOD Test Structure Estimates

Program  
Background

Blast/FX  
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► **Studies**

Questions



# Questions??

**Program  
Background**

**Blast/FX  
Model  
Overview**

**Studies**

▶ **Questions**